

HIGH RELIABILITY MULTI-TUBE THERMAL EXCHANGE STRUCTURE

Abstract of the Disclosure

For high reliability through redundancy, in a thermal chamber, heat exchange tubes are configured in multiple parallel runs. Typically three tubes are attached side-by-side in a strip which is formed into folded-back horizontal rows to be built into or attached to the walls of the chamber. In a freezer, each tube can serve independently as an evaporator when connected to a compressor/condenser source. Versatile source interfacing is provided by two valve-manifold routing units, one at each end of the multi-tube strip, enabling easy tube substitution in case of failure, as well as facilitating source-swapping, networking, defrosting and refrigerant operations such as purging, flushing, replenishing, changing or replacement, all without interrupting the required cooling process or affecting the chamber temperature. The multi-tube strip and valve-manifolds enhance the reliability of thermal systems such as ultra-low temperature biomedical freezers entrusted with critical at-risk payloads, and assist owner-operators in maintaining such systems fully operational with minimal need for outside repair expertise.